

Diagnostic and Control Panel for the Coherent Reference Generator

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This report describes the diagnostic and control system developed for the Coherent Reference Generator (CRG). All elements of this assembly are designed to have configuration control, failure analysis, and fault location performed either manually or by a remote computer. The mechanical control portion provides the selection of a frequency standard as well as either computer or manual mode of operation. To facilitate rapid system repair, all CRG input and output, signal levels, and power supply levels are monitored for performance within their specified limits, with the failed elements triggering the CRG alarm, and displaying the location of failure on the front panel.

I. Introduction

The Diagnostic and Control Panel for the Coherent Reference Generator (CRG) is designed in accordance with the requirements set forth in DSIF Standard Design Requirements 00001. This panel features fully automated performance monitoring, including indicators that allow the operator to determine the operational status of each module, as well as the presence of all input signal levels. Frequency standard selection is made by a single front panel switch, as is manual/computer selection, and fault indicator test. The elimination of complex displays, multiple switches, and controls assures the necessary performance requirements to minimize operator expense. To provide for future growth, this panel incorporates computer interface and control logic so that system

configuration, failure analysis, and fault location can be performed by a remote computer. The computer capability is designed such that all the necessary logic is on plug-in cards. This allows sites presently without computer control to eliminate the cost of the computer interface/control logic until such time that a computer does become available; then, to achieve full computer capability, all that will be required is to purchase the necessary cards and plug them into prewired sockets.

II. Implementation

A simplified block diagram of the Diagnostic and Control Panel (Fig. 1) shows the major logic functions. All inputs and outputs are internally monitored at the module level, and signal presence confirmation signals are

presented to the Diagnostic Panel as active transistor-transistor logic (TTL) "low" levels. All module status as well as power supply and switch conditions are fed in parallel to the CRG's good/bad alarm. If anything is out of tolerance, even if a module is not plugged in, the operator is alerted by an audio alarm and the remote computer sees a fail signal.

For description, this panel easily breaks down into two major functions: manual control and computer control. In the manual control mode, the frequency standard selection is accomplished with a mechanical fail safe switch so that if ac power is momentarily interrupted, the operator will not have to re-select the frequency standard. This switch also establishes the code for the station 1-MHz clock driver to assure that the proper secondary standard is selected in the event the primary fails. The individual module status lights shown in the lower-left corner of Fig. 2 indicate the location of a failed module using a grid system whereby each separate panel in the cabinet is numbered starting from the top as A1, A2, etc., and modules within a panel are numbered left to right as A1, A2, and A3 (i.e., the third module from the left in the sixth panel would be located by a light at position A6A3 in the front panel module grid). This method of module identification greatly reduces the cost of expansion and change, as control panel engraving will not have to be changed when modules are added. The input signal display, upper-left corner of Fig. 2, indicates if either the 1-MHz or the 5-MHz signal is not present, and if the 0.1-MHz or 10-MHz is not present. The station clock standard indicates the presence of the 1-MHz primary and secondary standards. This indicator provides a monitor on the backup frequency standard, which is automatically placed into service in event of a primary standard failure. Other front panel indicators display power supply and backup battery status. The condition of each coaxial switch in the frequency standard selector is displayed, as they are designed to be replaced by the operator in the event of failure. A test switch is designed into the front panel for the operator to check proper operation of the indicator lights. Four pushbutton switches select the

primary frequency standard, with adjacent lights verifying that the correct sequence of switch operations has taken place. A front panel switch with a mechanical lock selects either manual or computer mode of operations.

In the computer mode all front panel indicators operate. The computer interface is designed to be fully compatible with DSN Standard Interface Specification ES508534, and incorporates the hybrid handshaker circuit (Ref. 1). A single status output alerts the computer in the event of a Coherent Reference Generator failure, thus allowing the computer to perform functions other than continually monitoring all the individual modules. When the computer is alerted that there is an anomaly in the CRG, the DSN standard interface protocol is put into effect to interrogate the module status word generator, thereby locating and displaying the fault for operator action. Computer configuration control is initiated through the standard interface circuit only if the computer/manual switch is in computer mode.

The control circuit is designed using shift registers as digital filters to eliminate the possibility of noise on the interface lines from changing the frequency standard selection. The control sequence requires the computer to place the code corresponding to the frequency standard to be selected on data transfer lines (2) through (5) along with a separate control bit on data line (1) of the interface. After the handshaker has cycled through the proper protocol, an XEQ command generated by the handshaker is applied to the decoder, and the command is transferred to the frequency standard selector. The decoder has a volatile memory that is protected against power line outage by a backup battery system, thereby providing fail safe operation in both computer and manual modes.

III. Conclusion

The Diagnostic and Control Panel has been developed and fully tested in the laboratory. It has been installed and is operating at DSS 14, meeting all design goals. Present plans call for adding this capability to the remaining Coherent Reference Generators installed in the 64-m net.

Reference

1. Foster, C. F., *Complete Logical Operation and Test Procedure of Handshaker Circuit*, Spec. TP510942A, in preparation (JPL internal document).

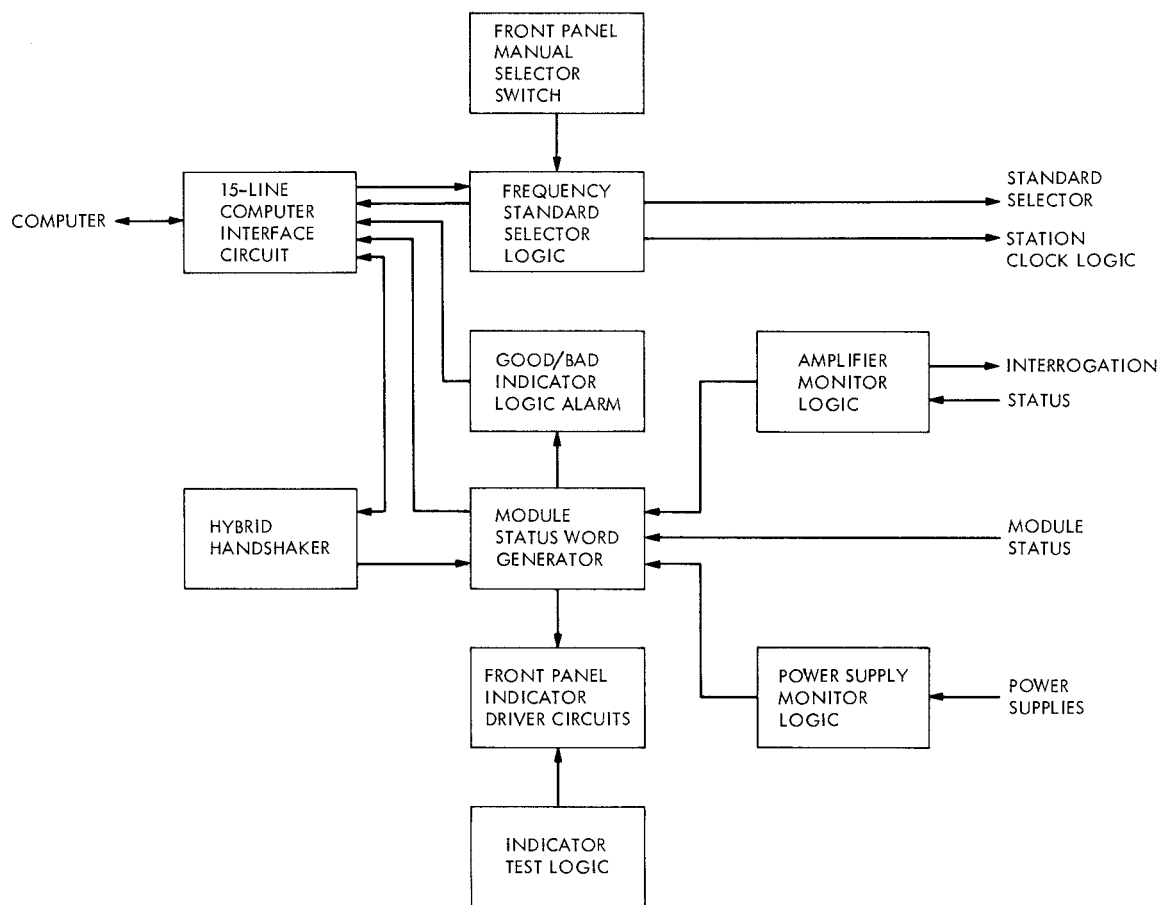


Fig. 1. Diagnostic and Control Panel simplified block diagram

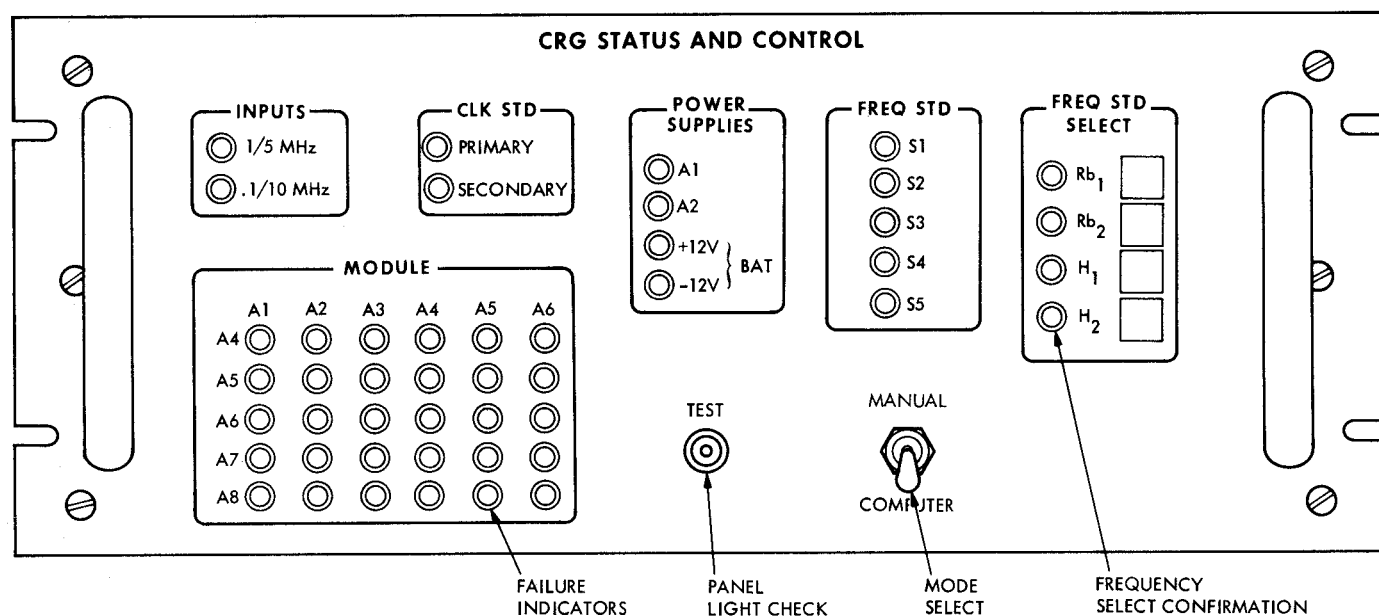


Fig. 2. Coherent Reference Generator Diagnostic and Control Panel